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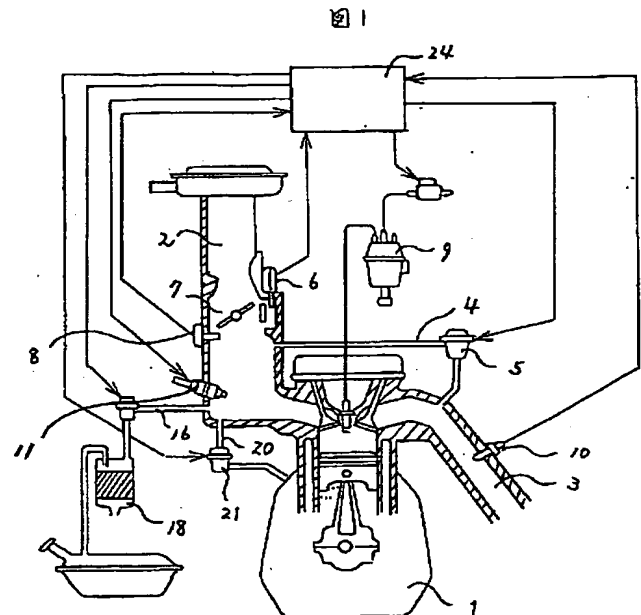
(54)【発明の名称】 内燃機関の流入空気量検出装置

(57)【要約】

【目的】 内燃機関の気筒へ流入する空気量を正確に計測し燃料噴射量を計算する。

【構成】 内燃機関の燃料制御において吸入する空気流量を質量流量計で計測し、その出力と、任意の吸気管負圧の時の流入空気量より、気筒へ流入する空気量と、吸気管負圧を計算し、内燃機関の要求する燃料量を計算する。

【効果】 内燃機関の吸気管負圧と気筒流入空気量を正確に計算できるので、定常時及び過渡時の空燃比を正確に制御できる。



【特許請求の範囲】

【請求項1】 内燃機関の吸気管の絞り弁を通過する空気流量の質量流量を計測する手段と、内燃機関の回転数を検出する手段と、少なくとも取得された前記絞り弁を通過する空気の前記質量流量と直前に計算された内燃機関の気筒への流入する空気量との差、および直前に推定された代表吸気管圧力にもとづき、前記吸気管内の現在の圧力を代表する代表吸気管圧力を推定する吸気管圧力推定手段と、推定された前記代表吸気管圧力と検出された前記内燃機関回転数から単位時間または単位回転数あたりの、前記気筒内に流入する空気質量流量を線形的に計算する気筒空気流量計算手段と、を備えていることを特徴とする内燃機関の流入空気量検出装置。

【請求項2】 前記絞り弁空気流量取得手段は、熱式空気流量計であることを特徴とする請求項1記載の内燃機関の流入空気量検出装置。

【請求項3】 前記気筒流入空気量計算手段は、1つの内燃機関の回転数にたいして少なくとも1つ以上の気筒流入空気量を記憶し計算にもちいることを特徴とする請求項1記載の内燃機関の流入空気量検出装置。

【請求項4】 前記気筒流入空気量計算手段は、1つの内燃機関の吸気管負圧にたいして少なくとも1つ以上の気筒流入空気量を記憶し計算にもちいることを特徴とする請求項1記載の内燃機関の流入空気量検出装置

【請求項5】 請求項1、2、3、または4記載の内燃機関の流入空気量検出装置と、前記内燃機関の流入空気量検出装置により計算された、前記気筒内に流入する空気質量流量に基づいて、燃料噴射装置が噴射する燃料噴射量を算出する燃料噴射量算出手段と、前記燃料噴射装置が算出された前記燃料噴射量の燃料を噴射するよう、該燃料噴射装置を制御する燃料噴射装置制御手段と、を備えていることを特徴とする内燃機関の燃料噴射量制御装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 本発明は、内燃機関の流入空気量検出装置より特に、熱式空気流量計を用いて内燃機関の必要とする燃料量を計算する制御装置に関する。

【0002】

【従来の技術】 従来の技術は、SAE920290に記載のように内燃機関の定常時における空気流量を、回転数と吸気管負圧で固定して計測しておきその計測値をマップとして制御装置内に記憶する。熱式流量計で計測された空気流量をもとに、このマップを検索して、内燃機関の気筒流入空気量を、吸気管負圧を計算するようにしていた。

【0003】

【発明が解決しようとする課題】 しかしこのように流入空気量をマップで検索しようとした場合検索する軸により取りえる値の最大値と最小値が固定されてしまい、正

確な気筒流入空気量が計算できなくなる。例えば、このマップを自然吸気の内燃機関に適用し、その後に過給器を設置すれば、マップの圧力上限を越えるため、再度測定しなおしとなる。又車輛の急減速のときには、内燃機関の回転数によっては、かなりの低負圧を示すことがあり、このようなときの吸入空気量を測定するのは困難である。本発明は、上記の問題を解決するために、気筒流入空気量をマップで求めるのではなく、理論的な計算で求めるようにしたものである。

10 【0004】

【課題を解決するための手段】 前記目的を達成するための内燃機関の流入空気量検出装置は、内燃機関の吸気管の絞り弁を通過する空気流量の質量流量を計測する手段と、内燃機関の回転数を検出する手段と、少なくとも取得された前記絞り弁を通過する空気の前記質量流量と直前に計算された内燃機関の気筒への流入する空気量との差、および直前に推定された代表吸気管圧力にもとづき、前記吸気管内の現在の圧力を代表する代表吸気管圧力を推定する吸気管圧力推定手段と、推定された前記代表吸気管圧力と検出された前記内燃機関の回転数から単位時間または単位回転数あたりの、前記気筒内に流入する空気質量流量を線形的に計算する気筒空気流量計算手段とを備えていることを特徴とするものである。

20 【0005】

【作用】 内燃機関の過渡時においては、吸気管の容積に流入した空気が充填されるため、内燃機関の絞り弁通過空気量と、気筒への流入空気量は、異なったものとなり、この時の内燃機関の空燃比は、大きく狂う。そのため熱式空気流量計の出力から、吸気管内圧力を推定し、気筒への流入空気量を計算する。しかし、内燃機関の状態により、気筒への流入空気量の充填効率が異なるため、この充填効率を補正する必要がある。しかし、回転数を固定し吸気管圧力方向へ流量をみた場合、流入空気量は、圧力と線形な関係となる。そこで各回転数にたいして、任意のポイントの流量を記憶しておき、この値をもとに回転数方向と圧力方向へ補間する。

30 【0006】

【実施例】 以下本発明の実施例を図を用いて説明する。

【0007】 図1は、本発明のシステムの全体の構成図である。内燃機関1には、内燃機関の吸入する空気料の質量流量を計測する熱式空気流量計6、内燃機関の吸気管の吸気圧力を計測する圧力センサ8、内燃機関1の排気管と吸気管を結ぶEGR還流通路4、EGR還流通路の途中に絞り弁として設けられたEGRバルブ5、車輛の燃料タンクの揮発分燃料を吸着し絞り弁制御により揮発分燃料を内燃機関の吸気管にパージするキャニスタパージ装置16、内燃機関1に燃料を供給する燃料噴射弁11、内燃機関の回転に同期して燃料を点火する点火装置9、排気ガスの酸素濃度を検知しその濃度より燃料量をフィードバックして理想空燃比にたもつ酸素濃度セン

サ10、離散系の数値処理で演算処理を行うマイクロコンピュータを内蔵し、上記のセンサ類の信号を処理し内燃機関の要求する燃料量、点火時期等を計算し、上記のバルブ類を駆動する内燃機関制御装置24、以上の装置から構成される。

【0008】図2は、内燃機関の空燃比制御装置の内部の回路ブロックを示す。図1におけるセンサ類からの信号を入力し、小信号をアクチュエータ駆動の大信号に変換するドライバ回路20、入出力信号をデジタル演算処理をおこなえるようアナログ-デジタル信号変換を行う入出力回路21、デジタル演算処理を行うマイクロコンピュータ、もしくはそれに準ずる演算回路を保有する演算回路22、演算回路22の演算処理に用いる定数、変数、およびプログラムを格納するメモリ23、メモリ22は不揮発性、揮発性の両者を示す。本実施例ではデジタル演算装置で構成されているが、アナログ演算装置で*

$$\begin{cases} \frac{dP}{dt} = K \cdot (Q_t - Q_c) & \dots\dots (1-1) \\ K = \frac{R \cdot T}{M \cdot V} & \dots\dots (1-2) \\ Q_c = \frac{P \cdot (N / 120) \cdot M}{R \cdot T} \eta & \dots\dots (1-3) \end{cases}$$

式1

P : 吸気管内負圧 Q_t : 絞り弁通過空気量 R : 気体定数
T : 吸気管内気体温度 H : 空気平均分子量 V : 吸気管内体積
N : エンジン回転数 η : 充填効率

【0011】吸気管内の圧力勾配は、絞り弁通過空気量と気筒流入空気量の差分に比例する。1-1式にそれを示す。比例定数は、理想気体の状態方程式から導きだされる。1-2式のRは気体定数、Tは吸気温度、Mは空気の平均分子量、Vは吸気管の絞り弁から気筒までの体積を示す。1-3式は気筒流入空気量と内燃機関の回転数、吸気管圧力の関係を示す。この式でわかるように、気筒流入空気量と内燃機関の回転数、吸気管圧力は、比※

$$\frac{dP}{dt} = K \cdot (Q_t - Q_c)$$



$$\frac{d}{dt} = \frac{1 - Z^{-1}}{\Delta t}$$

式2

$$P(i) = P(i-1) + K(Q_t - Q_c)$$

【0014】圧力勾配の微分演算子は、Z演算子を用いて、後退差分近似で差分式へと展開する。この時の演算は、演算周期を含んでいるので、この計算は、一定時間ごとに実行される。

【0015】図4と図5に、気筒流入空気量と内燃機関の回転数、吸気管圧力との関係の実測値を示す。図4は、吸気管圧力を固定し、回転数と流量の関係である。この場合、充填効率の非線形性により、きれいな直線とはならない。図5は、内燃機関の回転数を固定し、吸気

*も構成できる。又本実施例では、熱式空気流量計の出力信号、内燃機関の回転信号を入力し、点火信号、燃料噴射信号等を出力している。

【0009】図3は、内燃機関の吸気管内の気体の挙動を示している。内燃機関の吸気バルブの開閉による吸気管脈動を軽減するために吸気管の途中にサージタンク33が設置されている。熱式空気流量計30を通過した空気流量は、吸気管に設置された絞り弁31を通過する空気流量と同じである。図の32側は内燃機関の気筒側を示す。32側を通過する空気流量は、気筒流入空気量である。吸気管内圧力Pは、この絞り弁通過空気流量と、気筒流入空気流量に依存している。次に吸気管内の気体の理論式を式1に示す。

【0010】

【数1】

※例関係にある。ところでこの式には、非線形な内燃機関の気筒への充填効率を含んでおり理論的な比例関係にはならない。

【0012】次にデジタル演算処理を行うマイクロコンピュータで、吸気管内の圧力勾配から、圧力を求める方法を式2に示す。

【0013】

【数2】

管負圧と流量の関係を示したものである。吸気管の圧力方向は、充填効率は線形性を持ち、きれいな直線となる。

【0016】図6は、図4、図5の特性を応用して、気筒へ流入する空気量を計算する方法である。回転数固定で、吸気管圧力2ポイントの流量を計測しておき、この2ポイント間の流量は、補間計算にて計算する。又この2ポイントの流量は、内燃機関の各回転数にたいしテーブルで記憶しておき、テーブル検索を行う。この場合の

計算式を式3に示す。

【0017】

【数3】

$$\left\{ \begin{array}{l} Q_c = \frac{Q_{c1} - Q_{c2}}{P_1 - P_2} \times P_i \\ Q_{c1} = f(N) \\ Q_{c2} = g(N) \end{array} \right. \quad \text{式 3}$$

【0018】図7は、本実施例の内燃機関とは異なり、内燃機関の回転数と気筒流入空気量が、きれいな線形関係にある内燃機関の気筒流入空気量の計算方法である。この場合は、内燃機関の吸気管圧力2ポイントの流量を計測しておき、この間は補間計算を式4により行う。

【0019】

$$\left\{ \begin{array}{l} Q_c = a P_i^2 + b P_i + C \\ \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \frac{adj \ A}{|A|} \begin{bmatrix} Q_{c1} \\ Q_{c2} \\ Q_{c3} \end{bmatrix} \\ A = \begin{bmatrix} P_1^2 & P_1 & 1 \\ P_2^2 & P_2 & 1 \\ P_3^2 & P_3 & 1 \end{bmatrix} \end{array} \right. \quad \text{式 5}$$

【0022】図9は、式2で計算された吸気管負圧の吸気温補正の1例である。任意の2ポイントの吸気管負圧の時の気筒流入空気量にたいして、吸気温センサ等で計測された、吸気温から計算された吸気温補正定数を式6のように乗ずる。この1例では、吸気温補正定数は、吸気温にたいしてテーブル検索するようにしている。

【0023】

【数6】

$$\left\{ \begin{array}{l} Q_{c1} = f(N) \times KTW_1 \\ Q_{c1} = g(N) \times KTW_2 \\ KTW_1 = h_1(T) \\ KTW_2 = h_2(T) \end{array} \right. \quad \text{式 6}$$

【0024】図10は、吸気管負圧と気筒流入空気量の関係を、傾きと切片を与え、気筒流入空気量を求めている1例である。この場合、式7で示され、切片と傾きは、内燃機関の回転で検索する。

【0025】

【数7】

*【数4】

$$\left\{ \begin{array}{l} Q_c = \frac{Q_{c1} - Q_{c2}}{N_1 - N_2} \times N \\ Q_{c1} = f(P) \\ Q_{c2} = g(P) \end{array} \right. \quad \text{式 4}$$

【0020】図8は、図6の線形補間の1例にたいして、1次の補間ではなく、2次の補間を示したものである。任意の吸気管負圧の3ポイントにたいして、気筒流入空気量を求めておき、この3ポイントの数値から2次曲線を近似して、気筒流入量を式5により計算する。

【0021】

【数5】

$$\left\{ \begin{array}{l} Q_c = \theta \times P \times b \\ \theta = f(N) \\ b = g(N) \end{array} \right. \quad \text{式 7}$$

【0026】図11は、本実施例の制御のブロック図である。ブロックB1では、熱式空気流量計の出力電圧を、流量換算する。ブロックB2では、熱式空気流量計の出力と、内燃機関の気筒流入空気量の推定値の差分に定数を乗じ、全開の吸気管負圧計算値を加算し現在の吸気管負圧を計算する。ブロックB3では、計算された吸気管負圧と、任意の2ポイントの流入空気量から、流入空気量を計算する。この計算値を気筒流入空気量の推定値とする。ブロックB4では、内燃機関の回転数から任意の2ポイントの吸入空気量を検索するブロックである。

【0027】図12は、図11の例にたいして、ブロックB2_4に吸気温補正を加えた1例である。任意の2ポイントにたいして、それぞれの吸気温補正定数を乗じている。ブロックB2_5では、吸気温センサ等で計測された吸気温から、吸気温補正定数を検索するブロックである。

【0028】図13は、本発明のジェネラルフローチャートである。ステップS1では、熱式空気流量計の出力

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流入空気量を計算で算出するため、1回のデータ収集で、自然吸気および過給機付き内燃機関に多様に対応できる。

【図 1】 本発明の全体の構成図

【図3】 内燃機関の吸気管内の気体の挙動

【図5】 内燃機関の気筒流入空気量と吸気管内負圧

【図7】 気筒流入空気量の計算の1例に用いる線図

【図8】 気筒流入空気量の計算の1例に用いる線図

【図9】 気筒流入空気量の計算の1例に用いる線図

【図 1.0】 気筒流入空気量の計算の 1 例に用いる線図

【図 1 1】本発明の制御のブロック図の 1 例に用いる線

【図 12】 本発明の制御のブロック図の 1 例に用いる線

【図 13】 本発明の制御のフローチャート

【図 14】 本発明の制御のフローチャート

【符号の説明】

6…熱式空気流量計、24…内燃機関の空燃比制御装置、22…演算装置、B2…圧力差分計算ロジック、B4…気筒流入空気量回転数検索ロジック

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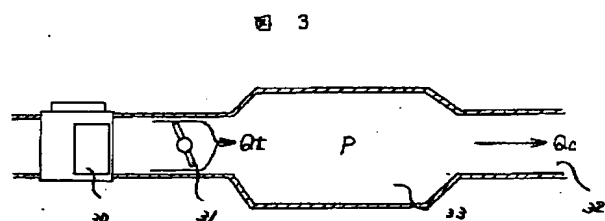
【0030】本実施例によれば、内燃機関の気筒へ流入する空気流量を正確に推定することができる。又モデルにもとずいて、気筒流入空気量を計算しているので、内燃機関の過渡時においても気筒流入空気量を正確に推定できる。

【0031】

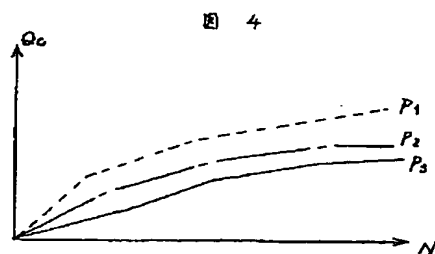
【発明の効果】本発明によれば過渡時において、吸気管の圧力を推定して気筒内へ流入する空気量を計算するので、空燃比を正確に制御できる。

【0032】又、予め記憶しておく定数が少ないので、記憶領域の節約、演算処理の高速化ができる。又、気筒

【图 3】

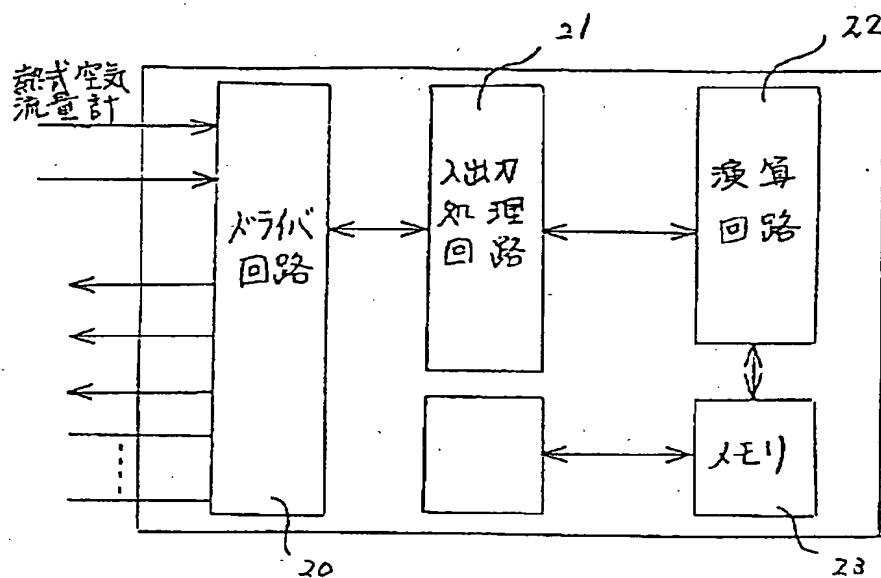


【図 4】



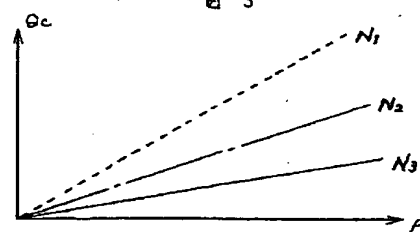
【図2】

図 2



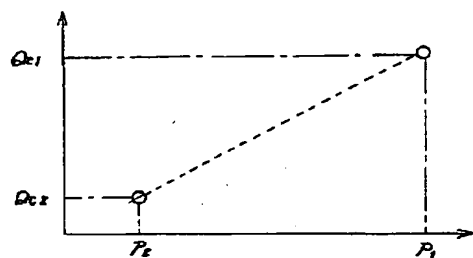
【図5】

図 5



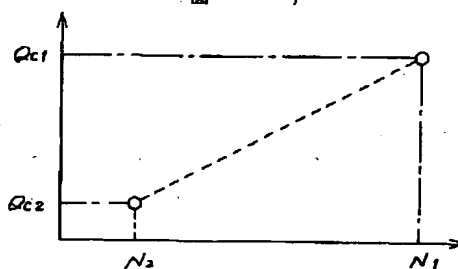
【図6】

図 6



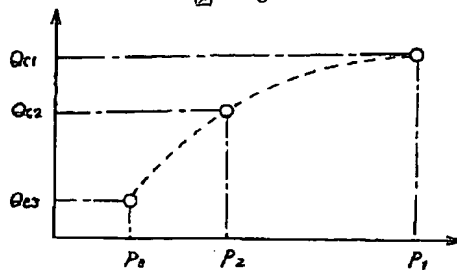
【図7】

図 7



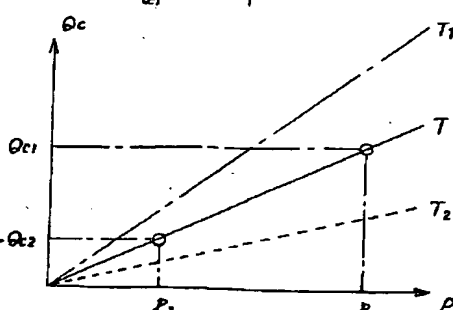
【図8】

図 8

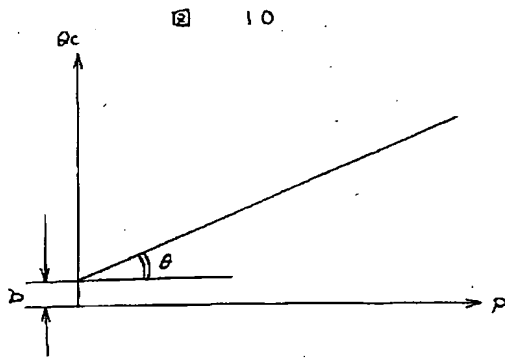


【図9】

図 9

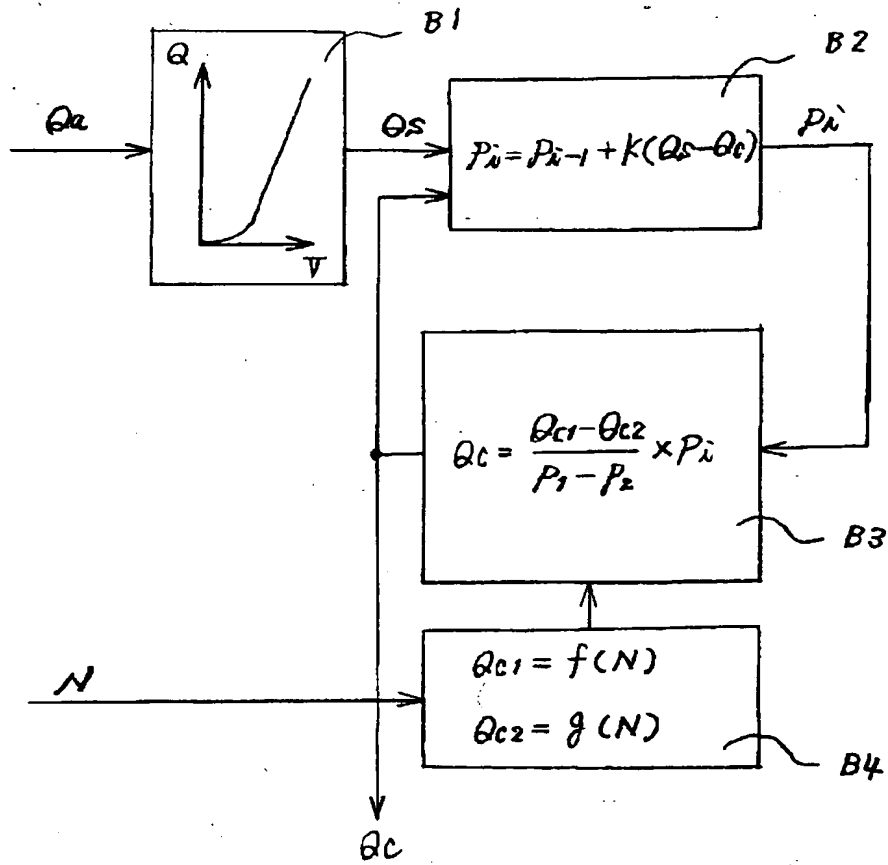


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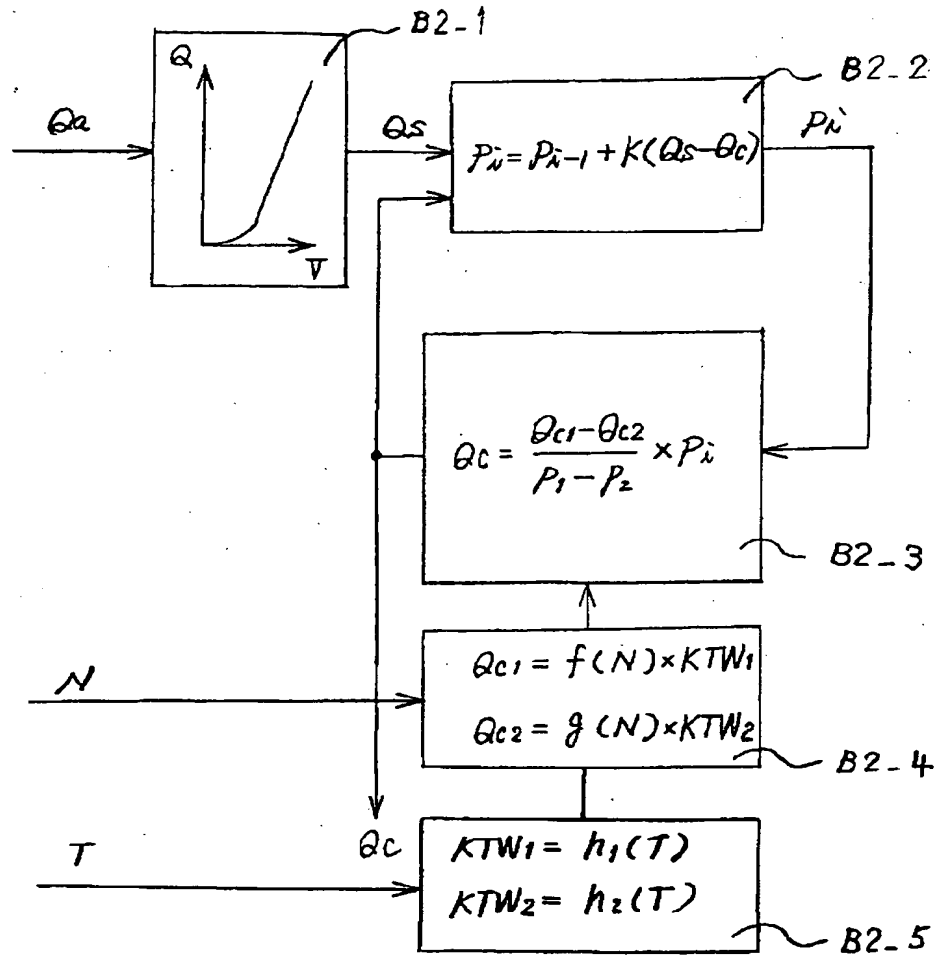
【図11】

図 11



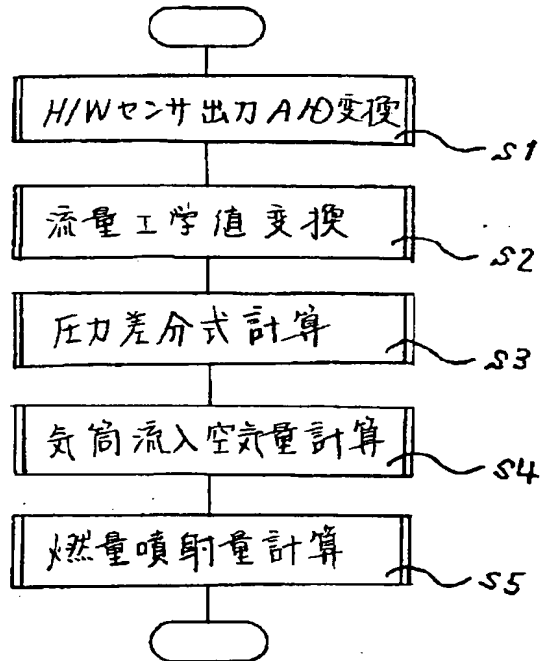
【図12】

図 12



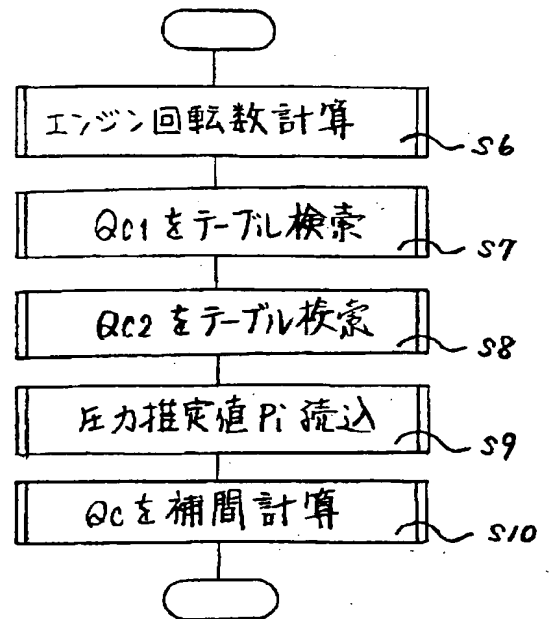
【図13】

図 13



【図14】

図 14



フロントページの続き

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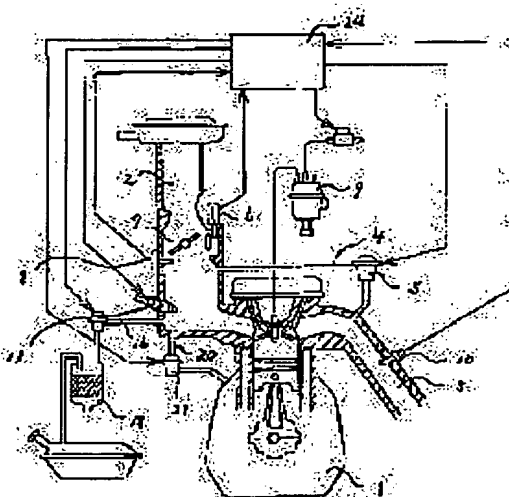
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(54) INFLOW AIR AMOUNT DETECTOR OF INTERNAL COMBUSTION ENGINE

(57)Abstract:

PURPOSE: To carry out the accurate control or the like of an air-fuel ratio and reduce a memory sphere and raise the speed or operation processing by calculating an air amount which flows into the cylinder of an internal combustion engine, through the surmise of the pressure of an intake pipe, seeking an intake air amount by means of theoretical calculation and not by means of a map.

CONSTITUTION: The controller 24 of an internal combustion engine 1, on the basis of respective detection signals from a heat type air flow meter 6, an intake air pressure sensor 8 and an oxygen sensor 10 or the like, controls respectively the EGR valve 5 of an EGR reflux passage 4, a fuel injection valve 11 and an ignition 9 or the like. In this instance, at the controller 24, on the basis of a difference between the mass flow of air which passes at the throttle valve 7 of an intake pipe 2, and the amount of air which flows into the internal combustion engine 1, and intake pipe pressure, representative intake pipe pressure is surmised. Moreover, on the basis of the representative intake pipe pressure and an engine revolution number, the mass flow of air per unit which flows into the internal combustion engine 1 is calculated linearly. As a result, the flow of air is sought not by means of a map but by means of theoretical calculation, and by this constitution, the accurate control or the like of an air-fuel ratio is accomplished.



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CLAIMS

[Claim(s)]

[Claim 1] A means to measure the mass flow rate of the air flow rate which passes the throttle valve of an internal combustion engine's inlet pipe, The difference of said mass flow rate of a means to detect an internal combustion engine's rotational frequency, and the air which passes said throttle valve acquired at least, and the flowing air content to an internal combustion engine's cylinder calculated just before, And a pressure-of-induction-pipe force presumption means to presume the representation pressure-of-induction-pipe force of representing the current pressure in said inlet pipe, based on the representation pressure-of-induction-pipe force presumed immediately before, Inflow air content detection equipment of the internal combustion engine characterized by having a cylinder air flow rate count means to calculate the air mass flow rate which flows in said cylinder per unit time amount or unit rotational frequency from said presumed representation pressure-of-induction-pipe force and said detected internal combustion engine rotational frequency in linearity.

[Claim 2] Said throttle valve air flow rate acquisition means is inflow air content detection equipment of the internal combustion engine according to claim 1 characterized by being a heat type air meter.

[Claim 3] Said cylinder inflow air content count means is inflow air content detection equipment of the internal combustion engine according to claim 1 characterized by memorizing at least one or more cylinder inflow air contents so much to one internal combustion engine's rotational frequency, having in count, and being.

[Claim 4] Said cylinder inflow air content count means is inflow air content detection equipment [claim 5] of the internal combustion engine according to claim 1 characterized by memorizing at least one or more cylinder inflow air contents so much to one internal combustion engine's inlet-pipe negative pressure, having in count, and being. Claims 1, 2, and 3 or the inflow air content detection equipment of an internal combustion engine given in four, A fuel-oil-consumption calculation means to compute the fuel oil consumption which is been and based on the air mass flow rate which was calculated by said internal combustion engine's inflow air content detection equipment, and which flows in said cylinder, and a fuel injection equipment injects, The fuel-oil-consumption control unit of the internal combustion engine characterized by having the fuel-injection-equipment control means which controls this fuel injection equipment so that the fuel of said fuel oil consumption with which said fuel injection equipment was computed may be injected.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the control unit which calculates the fuel quantity which an internal combustion engine needs especially using a heat type air meter from an internal combustion engine's inflow air content detection equipment.

[0002]

[Description of the Prior Art] The Prior art fixes and measures the air flow rate at the time of an internal combustion engine's stationary with a rotational frequency and inlet-pipe negative pressure like a publication to SAE920290, and memorizes it in a control unit by using the measurement value as a map. He searches this map and was trying to calculate inlet-pipe negative pressure for an internal combustion engine's cylinder inflow air content based on the air flow rate measured by the thermal type flowmeter.

[0003]

[Problem(s) to be Solved by the Invention] The maximum and the minimum value of the value which can be taken with the shaft searched when it is going to search an inflow air content with a map in this way will be fixed, and it becomes impossible however, to calculate an exact cylinder inflow air content. For example, if it is adapted for the internal combustion engine of natural aspiration in this map and a supercharger is installed after that, in order to exceed the pressure upper limit of a map, it is remeasuring again. Moreover, at the time of a sudden slowdown of a vehicle, it is difficult to show remarkable low negative pressure depending on an internal combustion engine's rotational frequency, and to measure an inhalation air content when such. This invention calculates it by theoretical count rather than calculates a cylinder inflow air content on a map, in order to solve the above-mentioned problem.

[0004]

[Means for Solving the Problem] The inflow air content detection equipment of the internal combustion engine for attaining said object A means to measure the mass flow rate of the air flow rate which passes the throttle valve of an internal combustion engine's inlet pipe, The difference of said mass flow rate of a means to detect an internal combustion engine's rotational frequency, and the air which passes said throttle valve acquired at least, and the flowing air content to an internal combustion engine's cylinder calculated just before, And a pressure-of-induction-pipe force presumption means to presume the representation pressure-of-induction-pipe force of representing the current pressure in said inlet pipe, based on the representation pressure-of-induction-pipe force presumed immediately before, It is characterized by having a cylinder air flow rate count means to calculate the air mass flow rate which flows in said cylinder per unit time amount or unit rotational frequency from the rotational frequency of said presumed representation pressure-of-induction-pipe force and said detected internal combustion engine in linearity.

[0005]

[Function] In an internal combustion engine's transient, since it fills up with the air which flowed into the volume of an inlet pipe, an internal combustion engine's throttle valve passage air content and the inflow air content to a cylinder become a different thing, and the air-fuel ratio of the internal combustion engine at this time is greatly out of order. Therefore, from the output of a heat type air meter, inlet-pipe internal pressure is presumed and the inflow air content to a cylinder is calculated. However, according to an internal combustion engine's condition, since the charging efficiencies of the inflow air content to a cylinder differ, it is necessary to amend this charging efficiency. However, when a rotational frequency is fixed and a flow rate is seen in the direction of the pressure-of-induction-pipe force, an inflow air content serves as a pressure and linearity relation. Then, to each rotational frequency, so much, the flow rate of the point of arbitration is memorized and it interpolates in the rotational frequency direction and the pressure direction based on this

value.

[0006]

[Example] The example of this invention is explained using drawing below.

[0007] Drawing 1 is the block diagram of the whole system of this invention. In an internal combustion engine 1 In the middle of the EGR reflux path 4 to which exhaust pipe and inlet pipe of the heat type air meter 6 which measures the mass flow rate of the charge of air which an internal combustion engine inhales, the pressure sensor 8 which measures the MAP of an internal combustion engine's inlet pipe, and an internal combustion engine 1 are connected, and an EGR reflux path, as a throttle valve EGR valve 5 and the volatile-matter fuel of the fuel tank of a vehicle which were prepared are adsorbed. By throttle valve control It synchronizes with a revolution of the fuel injection valve 11 which supplies a fuel to the canister purge equipment 16 which purges a volatile-matter fuel to an internal combustion engine's inlet pipe, and an internal combustion engine 1, and an internal combustion engine. The ignition 9 which lights a fuel, the oxygen density sensor 10 which detects the oxygen density of exhaust gas, feeds back fuel quantity and is maintained at an ideal air-fuel ratio from the concentration, and the microcomputer which performs data processing by numerical processing of a discrete time system are built in. Fuel quantity, ignition timing, etc. which process the signal of the above-mentioned sensors and an internal combustion engine demands are calculated, and it consists of an internal combustion engine control unit 24 which drives the above-mentioned bulbs, and equipment [more than].

[0008] Drawing 2 shows the circuit block inside an internal combustion engine's air-fuel ratio control system. The constant and the variable used for data processing of the driver circuit 20 which inputs the signal from the sensors in drawing 1 , and changes a small signal into the Taishin number of actuator actuation, the I/O circuit 21 which performs analogue-to-digital signal transformation so that digital data processing may be performed for an I/O signal, the microcomputer which performs digital data processing or the arithmetic circuit 22 which holds the arithmetic circuit according to it, and an arithmetic circuit 22 and the memory 23 which stores a program, and memory 22 show a non-volatile and volatile both. Although constituted from this example by the digital arithmetic unit, it can constitute also from an analog arithmetic unit. Moreover, in this example, the output signal of a heat type air meter and an internal combustion engine's revolution signal are inputted, and the ignition signal, the fuel-injection signal, etc. are outputted.

[0009] Drawing 3 shows the behavior of the gas in an internal combustion engine's inlet pipe. In order to mitigate the inlet-pipe pulsation by closing motion of an internal combustion engine's intake valve, the surge tank 33 is installed in the middle of the inlet pipe. The air flow rate which passed the heat type air meter 30 is the same as the air flow rate which passes the throttle valve 31 installed in the inlet pipe. 32 side of drawing shows an internal combustion engine's cylinder side. The air flow rate which passes 32 sides is a cylinder inflow air content. It depends for the inlet-pipe internal pressure P on this throttle valve passage air flow rate and a cylinder inflow air flow rate. Next, the theoretical formula of the gas in an inlet pipe is shown in a formula 1.

[0010]

[Equation 1]

$$\left\{ \begin{array}{l} \frac{dP}{dt} = K \cdot (Q_t - Q_c) \quad \dots\dots (1-1) \\ K = \frac{R \cdot T}{M \cdot V} \quad \dots\dots (1-2) \\ Q_c = \frac{P \cdot (N/120) \cdot M}{R \cdot T} \eta \quad \dots\dots (1-3) \end{array} \right. \quad \text{式 1}$$

P : 吸気管内負圧 Q_t : 絞り弁通過空気量 R : 気体定数

T : 吸気管内気体温度 H : 空気平均分子量 V : 吸気管内体積

N : エンジン回転数 η : 充填効率

[0011] The pressure gradient in an inlet pipe is proportional to the difference of a throttle valve passage air content and a cylinder inflow air content. It is shown in one to 1 formula. A proportionality constant is drawn from the equation of state of ideal gas. In R of 1-2 formula, an intake-air temperature and M show the average molecular weight of air, and, as for a gas constant and T, V shows the volume from the throttle valve of an inlet pipe to a cylinder. 1-3 formula shows the rotational frequency of a cylinder inflow air content and an internal combustion engine, and the relation of the pressure-of-induction-pipe force. The

rotational frequency of a cylinder inflow air content and an internal combustion engine and the pressure-of-induction-pipe force are in proportionality so that it may understand by this formula. By the way, the charging efficiency to a nonlinear internal combustion engine's cylinder is included in this formula, and it does not become theoretical proportionality.

[0012] Next, with the microcomputer which performs digital data processing, how to ask for a pressure is shown in a formula 2 from the pressure gradient in an inlet pipe.

[0013]

[Equation 2]

$$\frac{dP}{dt} = K \cdot (Q_t - Q_c)$$



$$\frac{d}{dt} = \frac{1 - Z^{-1}}{\Delta t}$$

式 2

$$P(i) = P(i-1) + K(Q_t - Q_c)$$

[0014] The differential operator of a pressure gradient is developed to a difference equation by retreat difference approximation using Z operator. Since the operation at this time contains the operation period, this count is performed for every fixed time amount.

[0015] The actual measurement of the relation between a cylinder inflow air content, and an internal combustion engine's rotational frequency and the pressure-of-induction-pipe force is shown in drawing 4 and drawing 5. Drawing 4 fixes the pressure-of-induction-pipe force, and is the relation between a rotational frequency and a flow rate. In this case, it does not become a beautiful straight line by the nonlinearity of a charging efficiency. Drawing 5 fixes an internal combustion engine's rotational frequency, and shows the relation between inlet-pipe negative pressure and a flow rate. A charging efficiency has linearity and the pressure direction of an inlet pipe serves as a beautiful straight line.

[0016] Drawing 6 is the approach of calculating the air content which applies the property of drawing 4 and drawing 5 and flows into a cylinder. By rotational frequency immobilization, the flow rate of two points of pressure-of-induction-pipe force is measured, and the flow rate for these two points is calculated by interpolation count. Moreover, this flow rate of two points is memorized on the table to each engine speed of an internal combustion engine, and performs table retrieval. The formula in this case is shown in an equation 3.

[0017]

[Equation 3]

$$\begin{cases} Q_c = \frac{Q_{c1} - Q_{c2}}{P_1 - P_2} \times P_i \\ Q_{c1} = f(N) \\ Q_{c2} = g(N) \end{cases} \quad \text{式 3}$$

[0018] Drawing 7 is the count approach of the cylinder inflow air content of the internal combustion engine which has an internal combustion engine's rotational frequency and cylinder inflow air content in beautiful linear relation unlike the internal combustion engine of this example. In this case, the flow rate of two points of an internal combustion engine's pressure-of-induction-pipe force is measured, and a formula 4 performs interpolation count in the meantime.

[0019]

[Equation 4]

$$\begin{cases} Q_c = \frac{Q_{c1} - Q_{c2}}{N_1 - N_2} \times N \\ Q_{c1} = f(P) \\ Q_{c2} = g(P) \end{cases} \quad \text{式 4}$$

[0020] Drawing 8 shows not the primary interpolation but the secondary interpolation so much to one example of the linear interpolation of drawing 6. Three points of the inlet-pipe negative pressure of

arbitration are asked so much for the cylinder inflow air content, a secondary curve is approximated from this numeric value of three points, and cylinder inflow is calculated by the formula 5.

[0021]

[Equation 5]

$$\left\{ \begin{array}{l} Q_c = a P_i^2 + b P_i + C \\ \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \frac{a d j}{|A|} \begin{bmatrix} Q_{c1} \\ Q_{c2} \\ Q_{c3} \end{bmatrix} \\ A = \begin{bmatrix} P_1^2 & P_1 & 1 \\ P_2^2 & P_2 & 1 \\ P_3^2 & P_3 & 1 \end{bmatrix} \end{array} \right. \quad \text{式 5}$$

[0022] Drawing 9 is one example of the intake temperature correction of the inlet-pipe negative pressure calculated by the formula 2. The cylinder inflow air content at the time of the inlet-pipe negative pressure of two points of arbitration is multiplied so much by the intake temperature correction constant which was measured with the intake temperature sensor etc. and which was calculated from the intake-air temperature like a formula 6. In this one example, the intake temperature correction constant is made to carry out table retrieval at an intake-air temperature so much.

[0023]

[Equation 6]

$$\left\{ \begin{array}{l} Q_{c1} = f(N) \times KTW_1 \\ Q_{c1} = g(N) \times KTW_2 \\ KTW_1 = h_1(T) \\ KTW_2 = h_2(T) \end{array} \right. \quad \text{式 6}$$

[0024] Drawing 10 is one example which gives an inclination and an intercept for inlet-pipe negative pressure and the relation of a cylinder inflow air content, and is calculating the cylinder inflow air content. In this case, it is shown by the formula 7 and an intercept and an inclination are searched with a revolution of an internal combustion engine.

[0025]

[Equation 7]

$$\left\{ \begin{array}{l} Q_c = \theta \times P \times b \\ \theta = f(N) \\ b = g(N) \end{array} \right. \quad \text{式 7}$$

[0026] Drawing 11 is the block diagram of control of this example. In block B1, the flow rate conversion of the output voltage of a heat type air meter are carried out. In block B-2, the difference of the output of a heat type air meter and the estimate an internal combustion engine's cylinder inflow air content is multiplied by the constant, the inlet-pipe negative pressure calculated value of full admission is added, and current inlet-pipe negative pressure is calculated. In block B3, an inflow air content is calculated from calculated inlet-pipe non-** and the inflow air content of two points of arbitration. Let this calculated value be the estimate of a cylinder inflow air content. In block B4, it is the block which searches the inhalation air content of two points of arbitration from an internal combustion engine's engine speed.

[0027] Drawing 12 is one example which added the intake temperature correction to the example of drawing 11 so much block B-2_4. Two points of arbitration are multiplied so much by each intake temperature correction constant. It is the block which searches an intake temperature correction constant with block B-2_5 from the intake-air temperature measured with the intake temperature sensor etc.

[0028] Drawing 13 is the general flow chart of this invention. At step S1, A/D conversion is performed for

the output voltage of a heat type air meter. At step S2, the electrical potential difference of a heat type air meter is changed into the flow rate. At step S3, it is the pressure difference equation which calculates inlet-pipe negative pressure from a cylinder inflow air content and the measurement flow rate of a heat type air meter. Step S4 calculates a cylinder inflow air content by the above-mentioned count approach. At step S5, the fuel oil consumption which an internal combustion engine needs by the calculated cylinder inflow air content is calculated.

[0029] Drawing 14 is the detail flow chart of the count approach of a cylinder inflow air content. An internal combustion engine's rotational frequency is calculated at step S6. The air flow rate of two points of arbitration is searched with steps S7 and S8 from an internal combustion engine's rotational frequency. In step S9, the inlet-pipe negative pressure by which the above-mentioned was calculated is read. Step S10 It can do and interpolation count of the cylinder inflow air content is carried out.

[0030] According to this example, the air flow rate which flows into an internal combustion engine's cylinder can be presumed to accuracy. moreover, a model -- a basis -- since ***** and a cylinder inflow air content are calculated, also in an internal combustion engine's transient, a cylinder inflow air content can be presumed to accuracy.

[0031]

[Effect of the Invention] Since the air content which presumes the pressure of an inlet pipe and flows into a cylinder in a transient is calculated according to this invention, an air-fuel ratio is controllable to accuracy.

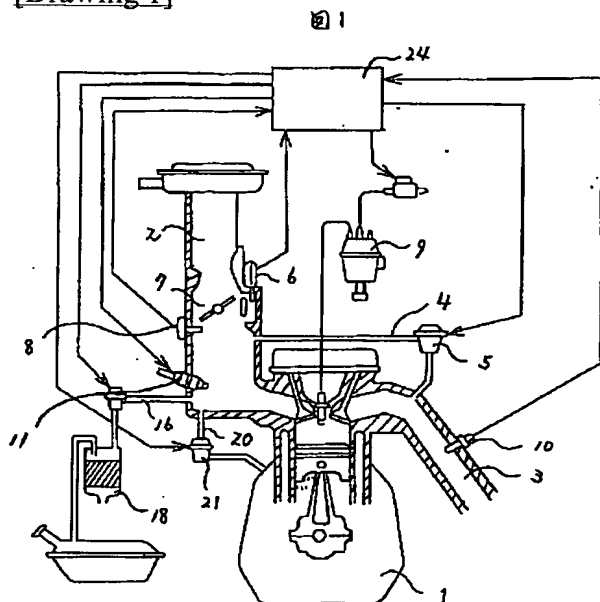
[0032] Moreover, since there are few constants memorized beforehand, economization of a storage region and improvement in the speed of data processing can be performed. Moreover, since a cylinder inflow air content is computed by count, it can respond to natural aspiration and an internal combustion engine with a supercharger variously by one data collection.

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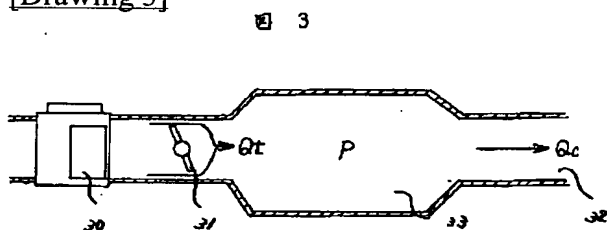
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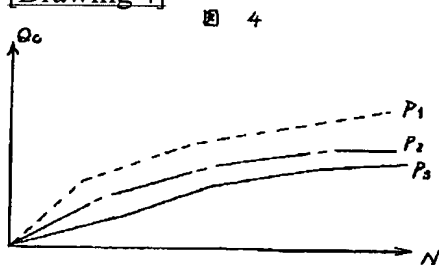
[Drawing 1]



[Drawing 3]

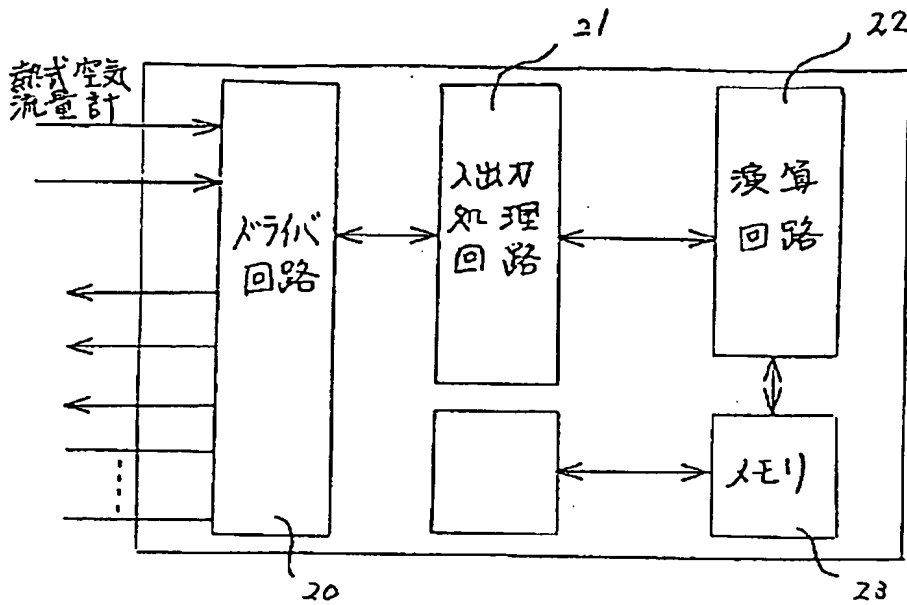


[Drawing 4]



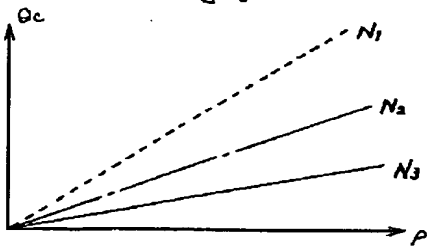
[Drawing 2]

図 2



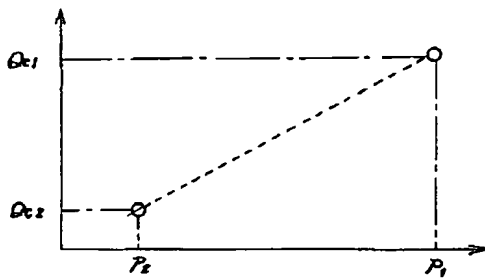
[Drawing 5]

図 5



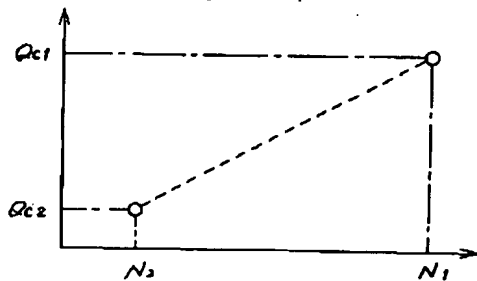
[Drawing 6]

図 6

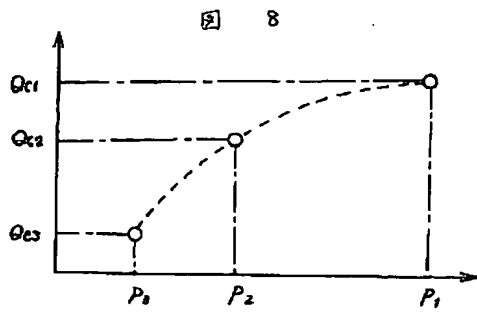


[Drawing 7]

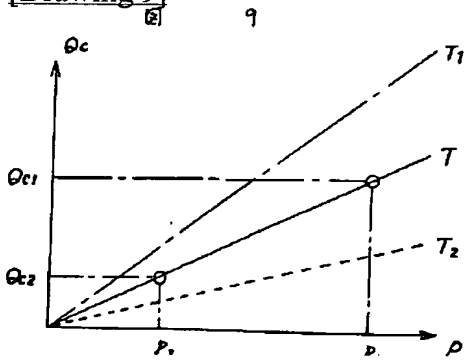
図 7



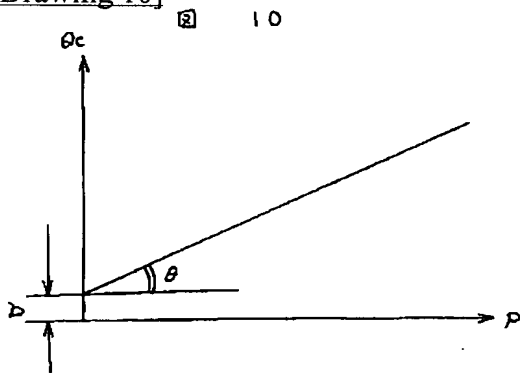
[Drawing 8]



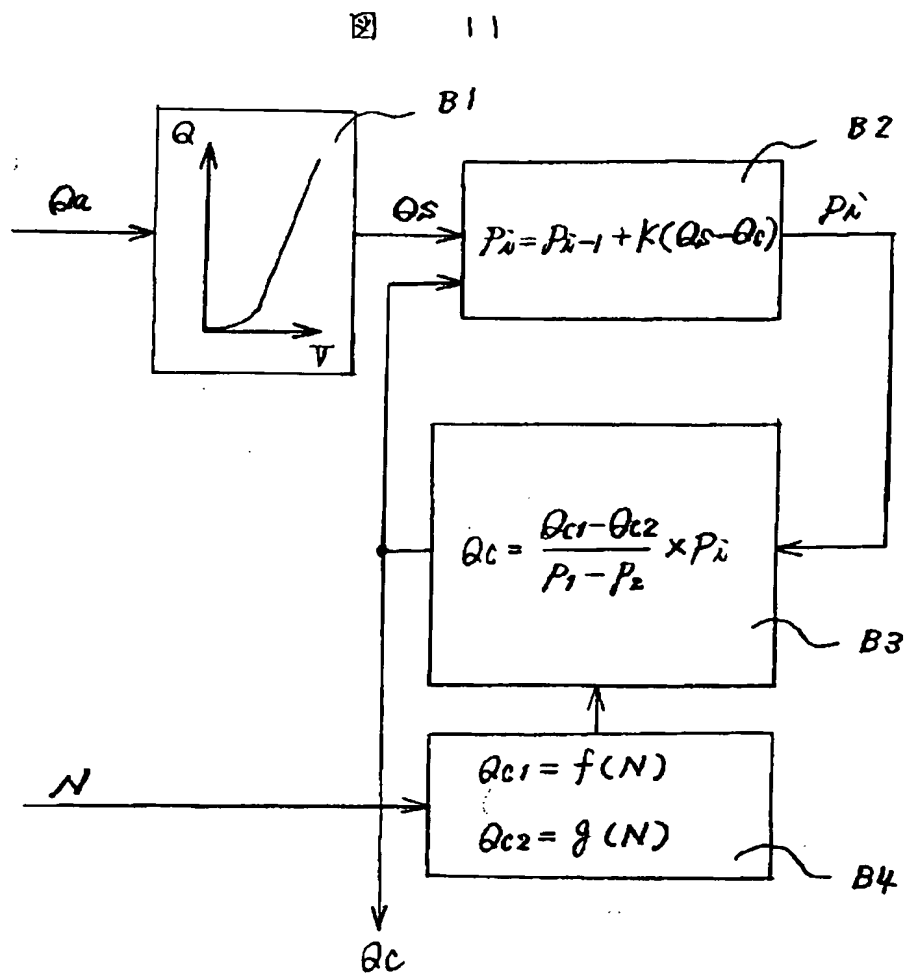
[Drawing 9]



[Drawing 10]

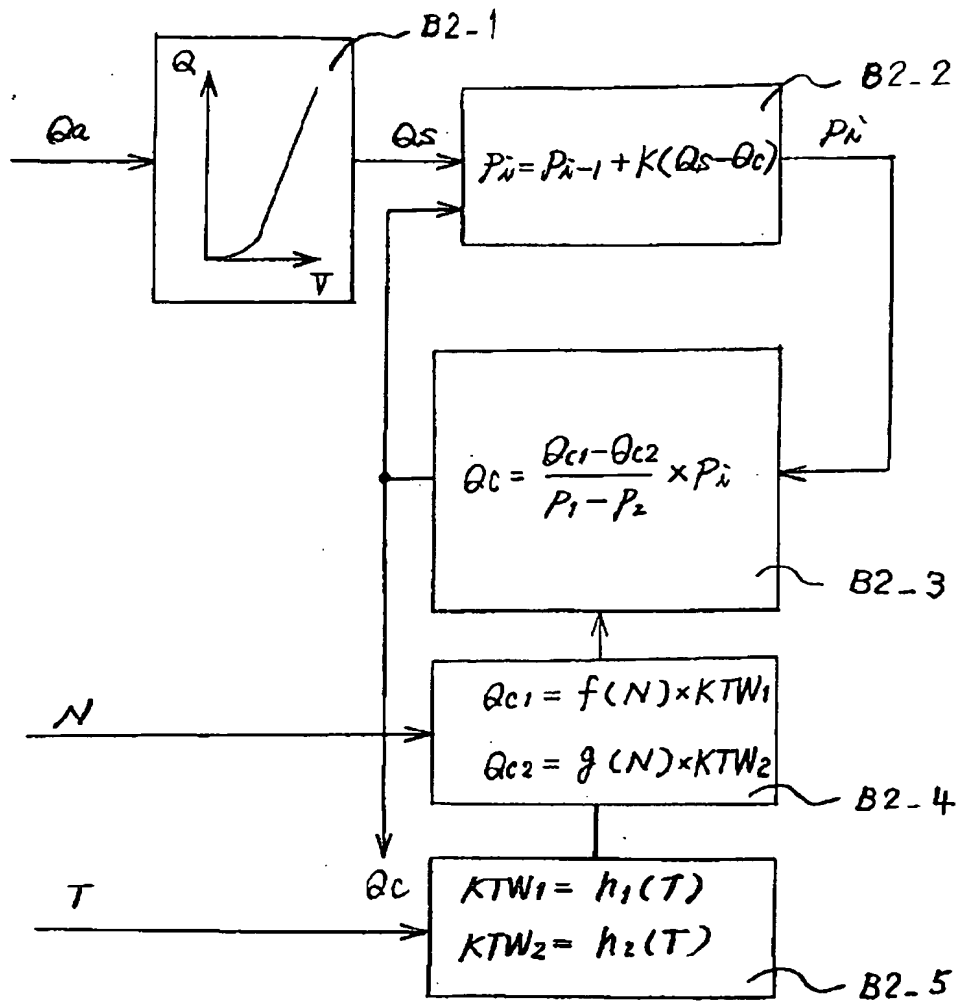


[Drawing 11]



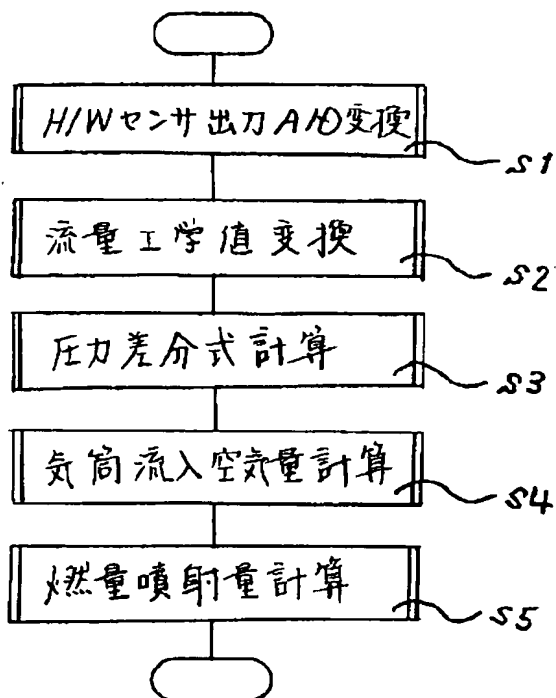
[Drawing 12]

図 12



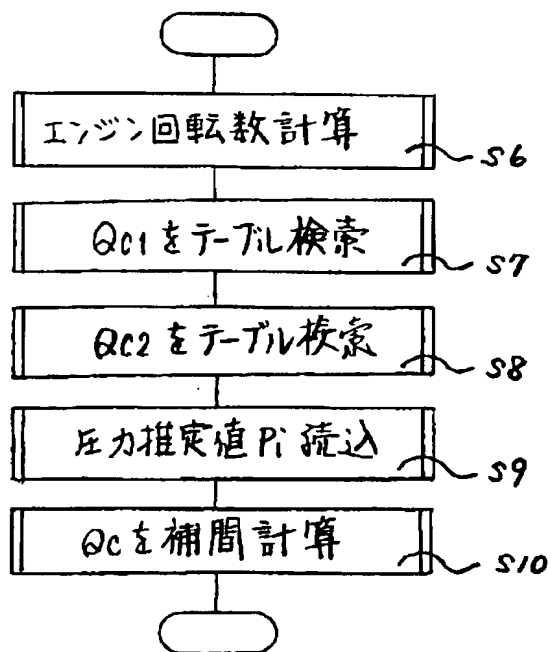
[Drawing 13]

図 13



[Drawing 14]

図 14



[Translation done.]